

CHAPTER II

RULES, REGULATIONS AND STANDARDS FOR WATER WELL CONSTRUCTION

As announced in the October 1985 issue of the LOUISIANA REGISTER, the Rules, Regulations and Standards for constructing Water Wells and Holes were prepared by the Louisiana Department of Transportation and Development, Office of Public Works, hereafter referred to as the "Department", in accordance with R.S. 38:3091 through 38:3098.8. The Rules, Regulations and Standards stated herein became effective on November 1, 1985 and preempted the Rules, Regulations and Standards for Water Well Construction which had been in effect since December 20, 1975.

SECTION 2.1.0.0

PURPOSE

The purpose of the Rules, Regulations, and Standards stated herein is to minimize the chances of contaminating the state's ground water resources via improperly constructed water wells and holes and to minimize health and safety hazards associated with construction of wells and holes. The Rules, Regulations and Standards shall apply to all water wells and holes, including but not limited to, public supply, domestic, irrigation/agriculture, industrial, power generation, rig-supply, observation, dewatering, monitoring, and heat pump supply, as well as pilot holes, test holes, geotechnical boreholes and heat pump holes (closed loop system). For glossary of terms, refer to Appendix I.

SECTION 2.2.0.0

GENERAL RULES AND REGULATIONS

SECTION 2.2.1.0

Approval of Plans and Specifications for Public Water Supply Systems.

- A) Louisiana Revised Statute 38:3094, paragraph (3) of subsection A, authorizes the Department to:

"Establish regulations governing standards for the construction of all water wells drilled after the effective date of this Act . . ."

Louisiana Revised Statute 40:4, paragraph (8) of subsection A of Section 4 (Sanitary Code) states:

"In order to protect the public against disease from water supplied for drinking, culinary, and abutionary purposes, the State Health Officer shall prepare and promulgate all rules and regulations necessary to insure that water supplied to the public by public water supplies is obtained from safe and sanitary sources and that such sources are properly protected; is treated, stored and conveyed in a safe and sanitary manner; and is safe and potable for human use . . ."

In accordance with these legislative directives, the Rules, Regulations and Standards governing construction of public supply water wells were prepared by the Department in close cooperation with the Louisiana Department of Health and Human Resources, Office of Preventive and Public Health Services, and they are intended to eliminate duplication of efforts and requirements by the two agencies, thereby minimizing cost and optimizing operating efficiencies.

- B) Chapter XII of the State Sanitary Code requires that no public water supply shall be constructed, operated or modified without review and approval of the State Health Officer. Detailed plans and specifications shall be submitted in duplicate to the Department of Health and Human Resources, Office of Preventive and Public Health Services, P.O. Box 60630, New Orleans, Louisiana 70160, by the person

having responsible charge of a municipally owned water supply or by the owner of a privately owned public water supply for review and approval before construction, modification, or operation of such system has commenced.

- C) The water well contractor shall construct the well in accordance with the applicable provisions of this chapter and shall submit a Water Well Registration Long Form (DOTD-GW-1) to the Department within thirty (30) calendar days after completing the well, as required by Section 1.2.0.0. of the Rules, Regulations and Procedures for Registering Water Wells and Holes.
- D) All questions relating to the quality of water, as it pertains to its effect on human health, shall be referred by the owner, engineer or water well contractor to the following:

Department of Health and Human Resources
Office of Preventive and Public Health Services
P.O. Box 60630
New Orleans, Louisiana 70160
Phone: (504) 568-5100

SECTION 2.2.2.0.

Licensing Requirements. The following wells and holes shall be drilled or constructed by a licensed contractor (driller) who is duly licensed by the Department in accordance with the Rules and Regulations stated in Chapter V:

- All water wells, regardless of use or type
- Monitoring wells
- Heat pump wells and holes
- Geotechnical boreholes
- Test holes and pilot holes

Additionally, reworking of water wells, as well as plugging and abandoning wells and holes, excluding oil and gas wells, shall also be undertaken by a licensed contractor.

SECTION 2.2.3.0.

Registration Requirements. Every water well or hole drilled in the State of Louisiana shall be registered with the Department in accordance with the requirements of Chapters I.

SECTION 2.2.4.0.

Variance Requests. Requests to vary from the Rules, Regulations and Standards for Constructing Water Wells and Holes shall be addressed to the Department as follows:

Department of Transportation and Development
ATTN: Chief, Water Resources Section
P.O. Box 94245
Baton Rouge, Louisiana 70804-9245
Phone: (504) 379-1434

The request must demonstrate that compliance is impractical and must outline a satisfactory alternative. The Department may prescribe, in writing, alternate requirements that are equivalent to the regulations and standards stated herein relating to the protection of aquifer and prevention of ground water contamination.

Requests to vary from the provisions of the State Sanitary Code relating to the sanitary features of the public supply water systems, and for questions related to the quality of water as it pertains to human health, shall be addressed to the following:

Department of Health and Human Resources
Office of Preventive and Public Health Services
P.O. Box 60630
New Orleans, Louisiana 70160
Phone: (504) 568-5100

SECTION 2.2.5.0.

Minimum Distance Requirements for Locating a Water Well. Provided that all other applicable rules and regulations are complied with, the minimum distance requirements for locating a water well shall be in accordance with the following sections:

SECTION 2.2.5.1.

Location in Relation to Possible Sources of Contamination. The horizontal distance between any water well and any possible sources of contamination shall be as great as possible but in no case less than the following minimum distances:

<u>POSSIBLE SOURCES OF CONTAMINATION</u>	<u>MINIMUM DISTANCE (in feet)</u>
Septic Tanks	50
Storm or Sanitary Sewer	50 <u>1/</u>
Cesspools, outdoor privies, oxidation ponds, subsurface absorption fields, pits, etc.	100 <u>2/</u>
Sanitary landfills, feed lots, manure piles, solid-waste dumps and similar installations	100
Another water well	25 <u>3/</u>
<u>Drainage canal, ditch or stream</u>	<u>50 <u>4/</u></u>

1/ This distance may be reduced to 30 feet if the sewer is of cast iron with leaded joints or Schedule 40 plastic pipe with water-tight joints.

2/ For domestic water wells, this distance may be reduced to fifty (50) feet.

3/ This minimum distance requirement does not take into consideration the effects of interference from pumping nearby wells in the same aquifer.

4/ Horizontally measured from the water edge to the well at the highest water level which may have occurred in a ten-year period.

SECTION 2.2.5.2.

Location in Relation to Levees.

- A) Wells shall not be drilled within 250 feet of the levees (R.S. 38:225, Subsection 6). The Department interprets this statute to mean that the well or wells shall be at least 250 feet from the land side toe of the levee.
- B) When wells are to be drilled within 1,500 feet of any state or federal flood control levee or structure, the owner or driller must first obtain permission from the appropriate levee board. The Corps of Engineers requires that drilling commence and casing be set and cemented in place to a specified depth while the stage of the Mississippi River is below +11.0 feet National Geodetic Vertical Datum (NGVD) on the Carrollton Gage, New Orleans, Louisiana, unless a waiver to this restriction is granted. Requests to vary from their requirements must be sent to the appropriate levee board and the Corps of Engineers. For specific information concerning river stages and drilling wells near levees, the owner, engineer or water well contractor should contact the following:

U.S. Army, Corps of Engineers
New Orleans District
P.O. Box 60267
New Orleans, LA 70160
Phone: (504) 862-2204

U.S. Army, Corps of Engineers
Vicksburg District
P.O. Box 60
Vicksburg, MS 39180-0060
Phone: (601) 634-5000

SECTION 2.2.5.3.

Location in Relation to Flood Water. Locations subject to flooding should be avoided, if possible. If a reasonable alternate site does not exist, the well may be constructed in flood-prone areas provided the top of

the casing is at least two (2) feet above the highest flood level which may have occurred in a ten-year period but in no case less than two (2) feet above the ground surface.

Well piping shall be constructed with a check valve or other appropriate apparatus to prevent introduction of surface water into the casing in the event of damage to the external piping or pressure tanks.

All rig-supply water wells must be properly capped between the time the well is completed and the time the well is put into water production at the site. The cap shall be watertight and securely attached to prevent easy entry by other than the owner and to prevent the introduction of flood waters or contaminants into the well.

Flood information may be obtained from the Department, the U.S. Geological Survey or the administering agency of the Federal Insurance Program (i.e., municipality, police jury, regional planning authorities, or the Department of Urban and Community Affairs).

SECTION 2.2.5.4.

Location in Relation to Buildings. A well shall be located far enough from a building to allow reworking or rehabilitation with a drilling rig. A well shall not be located below ground surface, such as in pits and basements, and shall not be located within the foundation of a building, except a building constructed solely to house pumping and water system equipment.

SECTION 2.3.0.0

DRILLING AND CONSTRUCTION

- A) Geologic conditions in Louisiana permit the use of two methods of drilling: the rotary method and reverse circulation method. Regardless of the method used, every precaution should be taken to prevent ground water contamination during drilling operations.
- B) Water used in drilling operations shall be potable or chlorinated to prevent contamination of water-bearing formations.
- C) When drilling a hole the contractor shall:
 - Record the hole diameter and any changes in size of hole,
 - Record (driller's log) the depth and thickness of the formations penetrated,
 - Record any unusual occurrences, such as loss of circulation, cave-ins, etc., and
 - Collect representative samples (drill cuttings) from each potential aquifer.
- D) The contractor shall properly maintain all materials, tools, and drilling equipment and shall take all measures necessary to minimize health and safety hazards and to prevent movement of surface water and contaminants into the drilled hole or well.
- E) An approved portable toilet shall be located at the drilling site if other restroom facilities are not available.
- F) The mud pit shall be so constructed and maintained as to minimize the contamination of the drilling mud.

- G) During a temporary shutdown for more than 24 hours, safeguards shall be taken to prevent possible contamination and damage. The well or hole shall be covered or capped to prevent entry by other than the contractor; it shall be clearly marked, and shall not be a safety hazard.

SECTION 2.3.1.0.

Alignment and Plumbness. The hole shall be drilled reasonably straight and plumb in order to:

- Avoid encroachment on neighboring property,
- Prevent intersection with other wells and holes,
- Prevent damage to screen while being set,
- Prevent damage to pumping equipment, and
- Allow for lowering the pump to the desired depth.

The contractor shall exercise reasonable care to ensure that the hole and the well are reasonably straight and plumb. Testing for plumbness and alignment are described in Section 8 and Appendix C of the current "American Water Works Association Standards for Water Wells" (AWWA A-100), as well as in Article 51 of the United States Environmental Protection Agency's "Manual of Water Well Construction Practices".

SECTION 2.3.2.0.

Drilling of Test Holes and Pilot Holes. A test hole is usually drilled to the base of the fresh water or to the bottom of the sand to be tested. Test holes are drilled primarily to:

- Determine the exact depth and thickness of the fresh-water bearing sands (aquifers),
- Collect drill cuttings for determining screen slot openings and the best location for the screen, and

- Collect quality and quantity of water data that can be used to design the well and select a pump and motor.

During the drilling operation, the contractor shall take the necessary precautions to prevent the contamination of any aquifer and the exchange of waters between aquifers.

When the drilling of a pilot hole or a test hole is temporarily suspended and the rig moves away from the drilling site, the hole shall be considered an abandoned hole unless drilling operations are resumed within thirty (30) calendar days of the initial date of suspension of drilling or an extension, in writing, is granted by the Department. During the "shut down" period, a mud column of sufficient weight and height shall be maintained in the hole at all times to prevent seepage of surface water and foreign materials into any aquifer and to prevent inter-aquifer movement of water. Additionally, the hole shall be capped and the immediate area shall be conspicuously marked to protect and warn the public. The cap shall be sufficiently strong and anchored to prevent easy and unintentional entry.

If the drilled test hole is deeper than the interval to be tested, the contractor shall use cement-bentonite slurry to set a plug extending from the bottom of the hole upward to a depth within twenty (20) feet of the bottom of the proposed screen setting or to the top of clay or shale layer underlying the sand to be tested. A sufficient period of time shall be allotted for the cement to set before development begins. If sands were not penetrated below the bottom of the sand to be screened, heavy drilling mud or bentonite slurry may be used in lieu of cement-bentonite slurry to plug the bottom of the hole.

If another aquifer at a shallower depth is to be tested, the contractor shall use cement-bentonite slurry to set a plug extending upward from the top of the plug, previously placed in the bottom of the hole, to within twenty

(20) feet of the depth where the bottom of the test screen is to be set in the shallower aquifer, or to the top of the clay or shale layer underlying the shallower sand to be tested.

Abandoned pilot holes and test holes shall be plugged in accordance with requirements of Sections 3.6.4.1. and 3.6.4.2., respectively.

SECTION 2.3.3.0.

Drilling of Heat Pump Holes (Closed Loop-System).

- A) Heat pump holes shall be constructed in accordance with the pertinent provisions of this chapter in order to protect fresh-water aquifers from surface contamination and to prevent movement of water of objectionable quality from one aquifer to another.
- B) Piping, casing or tubing materials shall conform to the applicable ASTM standards for polyvinyl chloride (PVC), polyethylene (PE), or polybutylene (PB) plastics and shall be installed and joined according to manufacturer's recommendations.
- C) If used, antifreeze compounds shall be non-toxic and approved for use by the U.S. Environmental Protection Agency.
- D) The entire depth of the closed loop heat pump holes shall be sealed in accordance with requirements of Section 3.6.4.4. within thirty (30) calendar days after completion of drilling operations.
- E) Service manifold should be protected from external forces as recommended by the manufacturer, designer and/or local building codes.

SECTION 2.3.4.0.

Drilling of Monitoring Wells.

- A) Monitoring wells shall be constructed in accordance with the pertinent provisions of this chapter in order to protect fresh-water aquifers from surface contamination and to prevent movement of water of objectionable quality from one aquifer to another.
- B) To prevent the introduction of extraneous compounds into the formation water, the use of drilling mud in the monitoring wells is discouraged.
- C) Monitoring wells shall be cased and the casing shall be strong enough to resist the forces imposed during and after installation, including reaction upon the casing by natural or foreign constituents or contamination.
- D) The entire annular space of the monitoring wells shall be sealed with cement-bentonite slurry, unless specified otherwise by the Department of Environmental Quality (DEQ). Prior to cementing, flushing of the annular space with water will be necessary when obstructions are present or suspected. Coarse ground bentonite or bentonite pellets shall be placed between the sand pack and the cement-bentonite slurry. The ground surface around the well shall be covered with a concrete slab at least four (4) inches thick, extending at least two and one-half (2 1/2) feet from the well in all directions. The surface of the slab shall be sloped to drain away from the well.
- E) Monitoring wells shall be covered with a protective cover or cap.
- F) Abandoned monitoring wells shall be plugged in accordance with requirements of Section 3.6.2.0.

NOTE: CONSTRUCTION OF MONITORING WELLS FOR FACILITIES REGULATED BY THE DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ) REQUIRES APPROVAL FROM THAT DEPARTMENT PRIOR TO CONSTRUCTION.

SECTION 2.3.5.0.

Drilling of Geotechnical Boreholes.

- A) Boreholes shall be drilled in accordance with pertinent provisions of this chapter in order to protect the fresh-water aquifers from surface contamination and to prevent movement of water of objectionable quality from one aquifer to another.
- B) Geotechnical boreholes shall be plugged in accordance with requirements of Section 3.6.4.3. within thirty (30) calendar days after the termination of drilling and sampling operations.

NOTE: DRILLING OF GEOTECHNICAL BOREHOLES FOR FACILITIES REGULATED BY THE DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ) REQUIRE SPECIAL CONSIDERATION BY THAT DEPARTMENT.

SECTION 2.3.6.0.

Reworking of Water Wells

- A) Rehabilitation or modification of water wells shall be accomplished in accordance with the provisions of this chapter of the Rules, Regulations and Standards for Water Well Drilling in order to protect the fresh-water aquifers from contamination.

The following operations shall be considered as reworking water wells and shall require a water well contractor's license.

- Removing and replacing screen
- Replacing gravel pack around screen
- Placing a new screen within the old screen

- Placing a liner pipe within the old casing
- Redeveloping a well by surging, acidizing, jetting, etc.

When a well is reworked or the sanitary seal is removed, the drop pipe, jet line or column pipe, pump/motor, etc. shall be cleaned and the well shall be disinfected in accordance with Chapter XII of the State Sanitary Code.

SECTION 2.4.0.0.

CASING

An appropriate casing shall be installed in every water well to prevent the wall of the hole from collapsing, to house the pump, and to convey the water to the surface.

SECTION 2.4.1.0.

General Criteria. The selection of casing is dependent upon a number of factors that shall be considered when designing and installing a well. Following are some of the factors:

- A) The casing shall be strong enough to resist the forces imposed during installation and other forces that can be expected after installation.
- B) The casing shall be of adequate diameter to accommodate the pump and convey the required quantity of water.
- C) Joints of metal casing shall have threaded couplings or be welded to ensure water tightness for the entire length of the casing.
- D) The casing shall be reasonably plumb and straight. The plumbness and alignment of the casing shall be checked in accordance with accepted practices (See Section 2.3.1.0.)

- E) The casing shall be installed so as to seal off water-bearing formations that contain undesirable water and to prevent water from the surface and other aquifers from entering the well.

SECTION 2.4.2.0.

Materials. The casing materials commonly used in Louisiana are metal and plastic. Concrete, clay tile, wood, fiberglass, and other synthetic casings have been used in the past in some areas for specific applications.

SECTION 2.4.2.1.

Metal Casing. Steel is the material most frequently used for well casing in drilled wells. The three principal classifications of steel used for water well casing are as follows:

- A) Standard and Line Pipe. This material shall meet one of the following standard specifications, including the latest revision thereof:

1. API Spec. 5A, "Specifications for Casing, Tubing and Drill Pipe."
2. API Spec. 5L, "Specifications for Line Pipe."
3. API Spec. 5LX, "Specifications for High-Test Line Pipe."
4. ASTM A53, "Specifications for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless Steel Pipe."
5. ASTM A120, "Standard Specifications for Pipe, Steel, Black and Hot Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses."
6. ASTM A134, "Standard Specifications for Pipe Steel, Fusion (Arc) - Welded Steel Pipe (Sizes NPS 16 and over)."
7. ASTM A135, "Standard Specifications for Electric-Resistant Steel Pipe."
8. ASTM A139, "Standard Specifications for Electric-Fusion (Arc)-Welded Steel Pipe (Sizes 4 inches and over)"

9. ASTM A211, "Standard Specifications for Spiral-Welded Steel or Iron Pipe."
10. AWWA C201, "AWWA Standard for Fabricated Electrically Welded Steel Pipe."
11. AWWA C202, "Tentative Standard for Mill Type Steel Water Pipe."
12. Underwriters Laboratories Standard 888.

B) Structural Steel. This material shall meet one of the following specifications of the American Society for Testing and Material, including latest revision thereof:

1. ASTM A36, "Standard Specification for Structural Steel."
2. ASTM A242, "Standard Specification for High-Strength Low-Alloy Structural Steel."
3. ASTM 570-79, "Standard Specifications for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality."
4. ASTM A283, "Standard Specifications for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars."
5. ASTM A441, "Standard Specification for High-Strength Low-Alloy Structural Manganese Vanadium Steel."

(Abbreviations used are: API - American Petroleum Institute; ASTM - American Society for Testing and Materials; AWWA - American Water Works Association.)

C) High Strength Carbon Steel. At present, there is no standard specification concerning this material; however, products are marked whose chemical and physical properties are similar. The material shall contain mill markings which will identify the manufacturer and specify that the material is well casing steel that complies with the chemical and physical properties as published by the manufacturer.

SECTION 2.4.2.2.

Plastic Casing. Thermoplastic well casing pipe may be used for well construction if it complies with the requirements and restrictions of this section.

A) Pipe and Material Specifications:

1. The thermoplastic well casing pipe and couplings shall be new polyvinyl chloride (PVC) material produced in accordance with the current AWWA Standard A-100 and ASTM F-480 standard, except that the impact standards of the current ASTM D-2241 may be substituted.
2. PVC material shall be designated as PVC 1120 or PVC 1220 and shall include an ultra-violet degradation inhibitor in its formulation.
3. Solvent cement shall conform to the current ASTM D-2564 standard.
4. Pipe may be joined by threaded joints, integral bell pipe or one piece couplings. Solvent-weld tapered bell and spigot joints shall meet current ASTM specification D-2672.

B) Casing Wall Thickness and Diameters:

1. The pipe shall have a standard dimension ratio (SDR) of 26, 21, or 17, and shall be equivalent to at least Schedule 40 or 80, depending upon use, construction techniques, depths and strength requirements.
2. Casing collapse pressures recommended by the manufacturer shall not be exceeded in any phase of well construction. Due consideration shall be given to extreme conditions that may

result from the use of high density cement grouts, high pressure cement grouting and high temperature from the heat of hydration in cement grouts.

3. Where threaded joints are used, wall thickness shall not be less than the equivalent of Schedule 80.

C) Marking and Approval:

1. The well casing pipe and couplings shall be marked in accordance with the current ASTM F-480 standard.
2. The well casing pipe, couplings, cement, primer and other compounds shall be evaluated and approved for use as a well casing in potable water supplies by the National Sanitation Foundation (NSF) Testing Laboratories, Inc, P.O. Box 1468, Ann Arbor, Michigan 48106.
3. The pipe shall be marked with the nominal size standard dimension ratio or schedule, type of material, either the designation "PVC 1120" or "PVC 1220", the wording "well casing", designation "ASTM F-480", manufacturers name or trademark, and the NSF-WC designation.

D) Storage:

1. The pipe and couplings shall be stored in a manner to minimize exposure to ultraviolet radiation.
2. The pipe shall be stored in a manner to prevent deformation, sagging or bending.

E) Assembly and Installation:

1. Joining techniques, including procedures for cutting, joint cleaning and priming, application of solvent cement, assembly and hardening time for solvent cement joints, shall be in accordance with the manufacturer's recommendations, and/or ASTM Standard D2855.
2. The well casing shall not be subjected to excessive forces and it may not be driven, pushed or forced into the formation.
3. PVC casing may be used to any depth, provided that allowable head differential (AHD) and hydraulic collapse pressure resistance (HCPR) are not exceeded. The well casing diameter and SDR or schedule shall be selected based on Appendix "L" of AWWA Standard A-100 and/or the manufacturer's recommendations for collapse pressure under extreme conditions.
4. PVC casing shall not be allowed to support the weight of the pump/motor (excluding submersible and single-pipe jet pump) and its related piping. The pump/motor, etc. shall be supported on a concrete base provided therefor.
5. Exposed PVC casings shall be protected from ultra-violet degradation by appropriate coatings as recommended by the manufacturer.

SECTION 2.4.3.0.

Height of Casing. Well casing shall project at least one (1) foot above ground level, pump-house floor, or the top of concrete slab. For wells in areas subject to flooding, refer to Section 2.2.5.3. The ground surface or concrete slab around the well shall be sloped to drain away from the well in all directions.

SECTION 2.5.0.0.

SCREEN.

Every water well shall be provided with an appropriate screen. It shall be the responsibility of the driller to determine the type of screen required, screen material, slot openings, entrance velocity, screen length and setting, and whether or not the well is to be gravel packed.

SECTION 2.5.1.0.

Type of Screen. The type of screen used is governed by cost, the contractor's experience with handling a specific type of screen, water quality, length of screen required, proposed well yield, and the required structural strength of the screen. The screen selected shall be strong enough to withstand external pressures and vertical load due to the weight of drill stem used to set the screen and the casing above the screen, if set in one continuous string.

SECTION 2.5.2.0.

Screen Material. The type of screen material is generally dependent upon cost and the quality of water to be pumped. If the water contains a relatively high concentration of carbon dioxide, dissolved solids or hydrogen sulfide, corrosion-resistant materials should be used in the construction of

the screen. The screen should be made entirely of the same material, and the lap or extension pipe (for not less than 5 feet) above the screen and blank pipe, if used, should be made of the same material as the screen. The likelihood of corrosion and encrustation can also be decreased by maintaining the entrance velocity within acceptable limits, 0.1 foot per second or less (See Section 2.5.4.0.).

Among metal alloys available with varying degrees of corrosion resistance are the stainless steels which combine nickel and chromium with steel and the various copper-based alloys. Manufacturers can be expected to provide advice on the type of metal or metal alloys that should be used if supplied with the results of a water analysis. Non-metal screens made of polyvinyl chloride (PVC) have been used as an alternative when corrosive conditions exist.

In contrast to "corrosive waters", encrusting waters are usually alkaline, have excessive carbonate hardness and contain iron and/or manganese. Encrustation, which reduces the open area of the screen and the specific capacity of the well, is the deposition of undesirable material about the screen openings. Efficient well development, which will decrease excessive head losses or pressure differentials across the face of the screen, will minimize the precipitation of encrusting minerals.

SECTION 2.5.3.0.

Screen Slot Openings. The selection of the screen openings, which shall be based on the results of mechanical analysis of the formation samples collected during drilling, is dependent upon the percentage of material that will be allowed to pass through the openings in the development process. Generally, the percentage of material that will be permitted to pass through the screen openings is related to the intended use of the water. Although

proper screen selection and well development should eliminate the pumping of sand during normal operations, cyclic pumping and increased pumping rates sometimes cause a well to yield some sand. Sand pumping by wells used to supply public and domestic water systems cannot be tolerated, whereas some sand in water used for irrigation is generally acceptable. Other factors involved in the selection of the slot openings are the uniformity of the material, the uniformity coefficient, the type of overlying sediments and the desired entrance velocity (See Section 2.5.4.0.).

Properly designed slot openings should allow the water to flow freely from the formation into the pump area while preventing clogging and sanding.

SECTION 2.5.4.0.

Entrance Velocity. To minimize the potential for encrustation, corrosion and "sanding", the entrance velocity should not exceed 0.1 foot per second. The entrance velocity is calculated by dividing the yield expressed in cubic feet per second (gallons per minute divided by 448.8 equals cubic feet per second) by the total area of the screen openings in square feet. The total area of the screen openings is the area of the openings provided per foot of screen multiplied by the length of screen in feet. Most manufacturers provide tables listing the open area for screen diameter and slot openings.

SECTION 2.5.5.0.

Screen Length. The length of the screen is influenced by cost, aquifer thickness, desired well yield and the estimated pumping level. The screen length should represent a compromise between cost and well efficiency. Well yield is more effectively increased by increasing the length of the screen than by proportionally increasing the diameter.

SECTION 2.5.6.0.

Screen Setting. Installation of the screen should be based upon an evaluation of all data collected during drilling and a detailed interpretation of the driller's and geophysical logs, if available. Care should be exercised to avoid damaging any part of the screen and to ensure that the setting is correct.

SECTION 2.5.7.0.

Gravel Pack. If the interval to be screened consists of a fine uniform sand or consists of thin alternating layers of fine, medium and coarse sand, it may be desirable to gravel pack the screen. The objectives of gravel packing are to increase the permeability of the material in the zone immediately surrounding the screen, to minimize the chances of sand pumping, to reduce the entrance velocity at the face of the screen, to reduce the chances of error where a screen is set opposite alternating beds of sand of different grain size and clay, and to allow the installation of a small diameter screen in relatively thick aquifers.

If required, a properly graded gravel pack shall be selected based upon an evaluation of the sieve analysis for the sands in the formation. The uniformity coefficient (see glossary of terms) of the selected gravel pack material should be 2.5 or less. The gravel envelope, usually 3 to 8 inches thick, should consist of clean, well-rounded siliceous material that will permit the selection of screen openings that will retain 90 percent or more of the gravel pack material by size. Limestone and shale shall not be used as a gravel pack.

SECTION 2.5.8.0.

Formation Stabilization. If the hole drilled to accommodate the screen is much larger (four inches or more) than the diameter of the well screen, it is sometimes necessary to stabilize the extension pipe with a material such as sand or gravel to prevent caving or slumping of silt, sand, and clay from above the aquifer. Formation stabilization should not be confused with gravel packing. In contrast to gravel packing, the material used as the formation stabilizer is not specially graded. In addition, commercially available equipment, such as shale packers or metal-petal baskets, are commonly used to prevent sloughing or caving into the producing formation.

SECTION 2.6.0.0.

METHODS AND STANDARDS FOR CEMENTING THE ANNULAR SPACE

The methods and materials employed to cement the annular space between the well casing and the borehole generally depend upon 1) local geohydrologic conditions, and 2) type of well construction. The primary reasons for sealing, cementing or grouting the annular space are as follows:

- To protect the aquifer from surface contamination,
- To increase the life of the well by protecting the casing against exterior corrosion, and
- To prevent movement of water of objectionable quality from one aquifer to another.

SECTION 2.6.1.0.

Methods for Cementing the Annular Space. The following regulations shall apply to all water wells, regardless of use or type:

- A) Annular space shall be sealed with cement-bentonite slurry, which is a mixture of cement, bentonite and water, consisting of not more than eight (8) percent bentonite by dry weight of the cement, and a maximum of ten (10) gallons of water per sack (94 pounds) of cement. Additives, in the approved and proper ratio, may be added to the slurry if required. If the slurry is to be prepared in the field, it is recommended that the bentonite be added after cement and water are thoroughly mixed.

Neat cement, which is a mixture of cement and water consisting of not more than five (5) gallons of water per sack (94 pounds) of cement, may be used in lieu of cement-bentonite slurry.

- B) Cement-bentonite slurry shall be placed in the annular space in a continuous operation from bottom of the space to be cemented, up to the ground surface. Slurry shall be placed by the circulation or pump-down method unless specified otherwise. The pump-down method may include the "Halliburton" method, inner string cementing, or positive placement-exterior method. The selected method should ensure uniform coverage of slurry throughout the annular space.
- C) A suitable cement retainer, packer, shale trap, boot or plug shall be secured to the casing at the appropriate depth to prevent leakage or migration of the slurry into the bottom of the well.
- D) The cement-bentonite slurry shall fill a minimum annular space of 1 1/2 inches for 4-inch and smaller wells, and a minimum of 2 inches for 6-inch and larger wells. For cementing methods using a "tremie" or "grouting pipe" placed in the annular space, sufficient space should be provided to accommodate the tremie pipe.

- E) If a conductor pipe is used, it shall be cemented in place and the annular space between the well casing and the conductor pipe shall be made watertight by grouting with cement-bentonite slurry from bottom of the conductor pipe to the ground surface.
- F) If one or more sands between the ground surface and the production sand contain saline water and/or water of objectionable quality, the annular space between the well casing and the hole shall be sealed with cement-bentonite slurry, at a minimum, to a depth of not less than twenty feet below the deepest sand containing the water of objectionable quality unless full depth cementing is required by Section 2.6.2.0.

SECTION 2.6.2.0.

Standards for Cementing the Annular Space.

- A) Community public supply wells shall be cemented to their full depth from the top of the producing aquifer to the ground surface.
- B) Non-community public supply wells shall be cemented from a minimum depth of fifty (50) feet to the ground surface.
- C) Industrial and power generation wells shall be cemented to their full depth from the top of the producing aquifer to the ground surface.
- D) Observation wells shall be cemented from a minimum depth of fifty (50) feet to the ground surface.
- E) Irrigation/agricultural wells shall be cemented from a minimum depth of ten (10) feet to the ground surface, using the pump-down or the gravity method with or without the tremie pipe.
- F) Rig-supply wells shall be cemented from a minimum depth of fifty (50) feet to the ground surface.

- G) Monitoring wells shall be cemented along the entire length of the casing unless specified otherwise by the Department of Environmental Quality.
- H) Dewatering wells, other than drive-point type, shall be cemented from a minimum depth of fifty (50) feet to the ground surface.
- I) Domestic wells shall be cemented from a minimum depth of ten (10) feet to the ground surface using the pump-down or the gravity method with or without the tremie pipe. A suitable cement retainer, such as a shale trap or boot, as required by Section 2.6.1.0. (C), shall be attached to the casing at the ten-foot minimum depth. The use of empty cement sacks in lieu of shale trap or boot shall not be allowed. A long metal rod shall be used to rod the cement slurry to ensure uniform coverage around the casing.
- J) Heat pump supply wells for private homes shall be cemented in accordance with requirements for domestic wells; for apartment buildings and other commercial establishments, in accordance with requirements for non-community public supply wells, and for industrial plants, in accordance with requirements for industrial wells.

SECTION 2.7.0.0.

WELL DEVELOPMENT AND DISINFECTION

SECTION 2.7.1.0.

Purpose and Methods of Development. The principal purposes of well development are as follows:

- To remove silt, sand, drilling mud, and other materials that may retard the flow of water toward and into the well,

- To correct any damages to, or clogging of, the water bearing formation that may have occurred during drilling, and
- To stabilize the material around the screen so that the well will yield clear "sand free" water.

The following methods used in developing, redeveloping or conditioning a well are acceptable:

- Surging with a plunger or piston while jetting using air lift,
- Jetting with water, also known as crosswashing,
- Backwashing or surging by alternately starting and stopping the pump,
- Using chemicals designed for developing or redeveloping a well,
- Over-pumping.

The use of explosives is prohibited. Water used for well development shall be potable or chlorinated to prevent contamination of water-bearing formations.

SECTION 2.7.2.0.

Criteria for Development. A well should be developed at a yield of 1.5 times the proposed pumping rate and, if possible, it should continue until the observed specific capacity is the same, or nearly the same, as the theoretical specific capacity. Adequately developed wells should be "sand free" and should have fewer encrustation problems if the operating pumping rate is about two-thirds the developed rate, the entrance velocity is 0.1 foot per second or less, and the head differential across the face of the screen is at a minimum.

The acceptable amount of sand per unit volume should be between recommended ratios of one ounce of sand per 8,000 gallons of water (about 1 milligram per liter) and one ounce per 100 gallons of water (80 milligrams per liter), depending on the use of water. Because of the possibility of damage

by sand to plumbing fixtures and industrial equipment and products, the tolerance for sand in water used for public supply, domestic and most industrial purposes is low and should not exceed five (5) milligrams per liter. Many wells that are used for public water supply systems have an acceptable ratio of "no sand". The well owner should specify the acceptable limits of the "sand free" water with equal consideration given to the use of the water, the desired production rate, costs, and well development.

SECTION 2.7.2.1.

Development of Gravel-Packed Wells. The successful development of a gravel-packed well is dependent upon the grading of the gravel, the method of development, and thickness of the skin of the relatively impervious drilling mud filter cake which is "plastered" on the wall of the hole and is between the water-bearing formation, and the emplaced gravel. Because it concentrates energy in small areas, the jetting or cross washing method is usually the most effective in developing gravel-packed wells.

SECTION 2.7.2.2.

Chemicals Used in the Development Process. Glassy polyphosphate chemicals, if used strictly in accordance with the manufacturer's recommendation, will aid in the development or redevelopment process by reducing the gel-like properties of the drilling mud and by dispersing the clay particles that are on the sand grains.

The appropriate ratio of chemicals to water in the well is usually specified by the manufacturer. The mixture should be allowed to stand in the well for at least one hour, or the period of time recommended by the manufacturer of the chemical, before development starts. It should be noted that the polyphosphate should not be allowed to remain in the well for too

long (several days). If the chemicals converted to the glassy orthophosphate state, any clay in suspension could be deposited, perhaps out of reach of any further removal, resulting in permanent reduction in yield.

Chemicals used in the development process shall either meet the standards of the American Water Works Association or be approved for use by the U.S. Environmental Protection Agency (EPA).

SECTION 2.7.3.0.

Disinfection of Wells. All new wells and existing wells in which repair work has been done shall be disinfected before being put into use, in accordance with Chapter XII of the State Sanitary Code, if water is to be used for drinking, cooking or washing purposes. Negative bacteriological analysis of water, performed by the Department of Health and Human Resources (DHHR) or by a laboratory certified by the State Health Officer, shall be required for all public supply and domestic water wells.

SECTION 2.8.0.0.

STANDARDS FOR MISCELLANEOUS APPURTENANCES

SECTION 2.8.1.0.

Vent (Breather Pipe). Vents are required for all public supply water wells and are recommended for use on wells used for other purposes. Vents shall be so constructed and installed as to prevent the entrance of contaminants into the well. Vent openings shall be piped water-tight to a point at least two (2) feet above the highest flood level which may have occurred in a ten-year period, but in no case less than one (1) foot above the top of the well casing. Such vent openings and extensions thereof should not be less than one-half inch in diameter, with extension pipe firmly attached

thereto. The openings of the vent pipes shall be turned downward and screened to prevent the entrance of insects, foreign matter and other contaminants. Vents will not be required when single-pipe jet pumps are used.

SECTION 2.8.2.0.

Sampling Tap. All public supply and domestic water wells shall be provided with a readily accessible faucet or tap on the well discharge line at the well head for the collection of water samples. The faucet or tap shall be of the smooth nozzle type and turned downward.

SECTION 2.8.3.0.

Concrete Slab. When concrete slabs are placed around water wells at ground surface, they should be at least four (4) inches thick and extending at least two and one-half (2 1/2) feet from the well in all directions. The surface of the slab shall be sloped to drain away from the well. The top of the casing shall be at least one (1) foot above the top of the slab. Prior to the slab installation, the contractor shall seal the annular space in accordance with section 2.6.0.0. THE PLACEMENT OF A SLAB SHALL NOT BE CONSIDERED A SUBSTITUTE FOR THE PLACEMENT OF CEMENT-BENTONITE SLURRY IN THE ANNULAR SPACE BETWEEN THE HOLE AND THE CASING.

For wells where a slab is not provided, the ground surface surrounding the well shall be compacted and graded to drain water away from the well.

SECTION 2.8.4.0.

Sanitary Seals. A water-tight sanitary seal shall be installed at the top of the casing for all water wells to prevent the entrance of contaminated water or other objectionable material into the well. Sanitary seals shall be constructed of a durable material such as cast iron, steel, aluminum, high

impact plastic, neoprene, or a combination thereof. If a vent and/or an electrical conduit enter the well casing through the sanitary seal, the openings shall be made water-tight.

SECTION 2.8.5.0.

Pump/Motor Base. To prevent transmission of vibration to the well casing, all surface-mounted pumps/motors (excluding submersible and single-pipe jet pumps/motors) shall be supported by a concrete base, pier or foundation. The well casing shall not be used to support the weight of the surface-mounted pump/motor, except as noted above. Foundations may either be split pier type or solid pedestal type. For solid pedestal foundations, the well casing shall project at least one inch above the level of the foundation.

SECTION 2.9.0.0.

ENFORCEMENT ACTIONS

Provisions addressing enforcement of this Chapter appear in Louisiana Revised Statute 38:3096, as follows:

A) Whoever knowingly and willfully violates a provision of this chapter, or a rule, regulation, or order of the director or a board made hereunder, shall be subject to a civil penalty of not more than One Thousand Dollars a day for each day of violation and for each act of violation if a penalty for the violation is not otherwise provided in this chapter.

(1) The place of suit to recover this penalty shall be selected by the director or board, as may be appropriate, in the district court of the parish of the residence of any one of the defendants, or in the district court of the parish where the violation took place.

- (2) Suit shall be at the direction of the director or board, as may be appropriate, and shall be instituted and conducted in his or its name by the Attorney General or by the District Attorney of the district under the direction of the Attorney General.
- B) Whoever knowingly and willfully aids or abets a person in the violation of a provision of this chapter, or in any rule, regulation, or order made hereunder, shall be subject to the same penalties provided herein for the principal violator.

SECTION 2.9.1.0.

Falsification of Documents. Falsification of documents to evade regulations, as well as penalties for said falsifications, appears in Louisiana Revised Statute 38:3095, as follows:

- A) No person shall, for the purpose of evading this chapter, or any rule, regulation, or order made thereunder:
- (1) Make or cause to be made any false entry or statement of fact in any report required to be made by this chapter or by any rule, regulation, or order made hereunder; or
 - (2) Make or cause to be made any false entry in an account, record, or memorandum kept by any person in connection with the provisions of this chapter or of any rule, regulation, or order made thereunder; or
 - (3) Remove out of the jurisdiction of the State, or destroy or mutilate, alter, or by any other means falsify any book, record, or other paper pertaining to the matters regulated by this chapter or by any rule, regulation, or order made thereunder.

B) Whoever violates this section shall be fined not more than Five Thousand Dollars or imprisoned not more than six months or both.

The penalty provision for falsification of documents required under the provisions of this chapter are therefore criminal in nature and will be enforced through the District Attorney having jurisdiction where said violation occurs. It should also be noted that utilization of the United States Mail in the falsification of documents constitutes a violation of Title 18 of the United States Code (Mail Fraud), and such information will be referred to the appropriate United States Attorney.

SECTION 2.9.2.0.

Appeals. An alleged violator may appeal any order of the Department by requesting a hearing. The hearing request must be made to the Department, in writing, within thirty (30) calendar days of the original order and must be sent by "Certified Mail-Return Receipt Requested". After receiving the request, the Department will arrange a hearing to determine what other remedial action will serve to effect compliance with the rules and regulations.